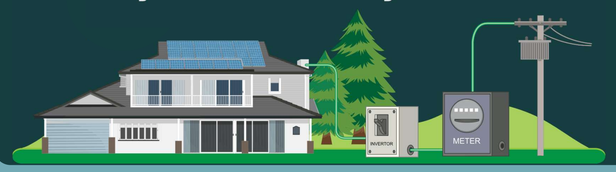
Ollscoil Mhá Nuad
Maynooth University



OPTIMIZING RESIDENTIAL SOLAR + BATTERY SCHEDULING

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SUMMARY

- Solar + battery systems can schedule energy use efficiently to meet household needs and boost energy security
- Comparing MILP optimization to rule-based methods shows MILP can better tailor battery scheduling using real data and tariffs
- MILP lets users set priorities like cutting costs, lowering CO_2, or reducing grid reliance via flexible controls.

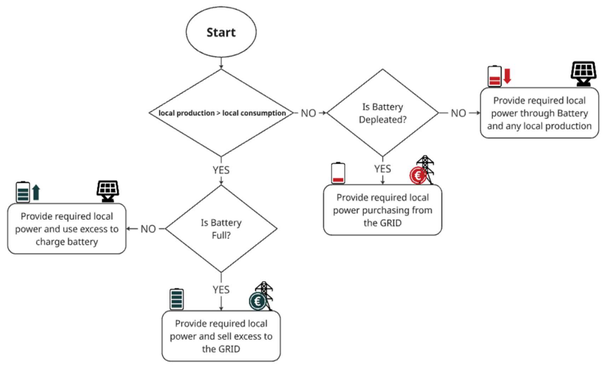
INTRODUCTION & MOTIVATION

- More Irish homes now use renewables and batteries, with 94,000 solar installs by 2024. (SEAI, 2024).[1]
- Smarter energy management is needed; simple rule-based scheduling can't handle all cost and energy trade-offs.
- During our literature review we identified MILP as one of the leading alternatives

METHODOLOGY

RULE-BASED

- These algorithms combine "Time-of-Use (ToU) arbitrage" and "self-consumption maximisation" using **simple threshold-based decisions.**
- Cannot simultaneously optimize multiple objectives or adapt based on predicted conditions.
- **Near-instantaneous** execution with minimal processing requirements, making them suitable for real-time implementation.

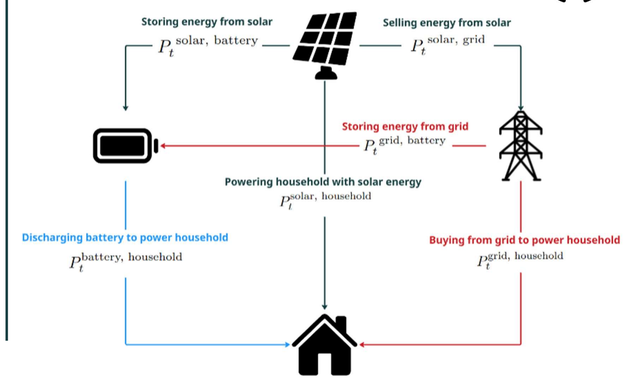

Start
local production > local consumption
NO
Is Battery Depleated?
NO
Provide required local power through Battery and any local production
YES
YES
Provide required local power and use excess to charge battery
NO
Is Battery Full?
Provide required local power purchasing from the GRID
YES
Provide required local power and sell excess to the GRID

MILP

- Uses a **Mathematical Model to** Optimize scheduling using battery specs, solar capacity, consumption patterns, and electricity pricing as inputs
- We chose to use '**Gurobi**'; solvers find globally optimal solutions within seconds, offering excellent academic licensing for resource-intensive computations

GUROBI OPTIMIZATION

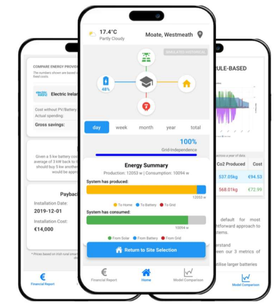
- The full system model is available upon request and on github![2]



DEVELOPED MOBILE APP

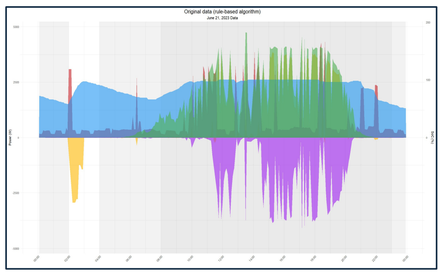
- Explore real performance data
- Advice on batteries and providers
- Visualize potential savings

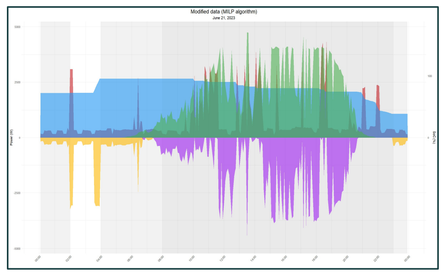
- Anyone can access the mobile app using the QR code below



ANALYSIS

Site 1 – ' Night Boost ' Tariff



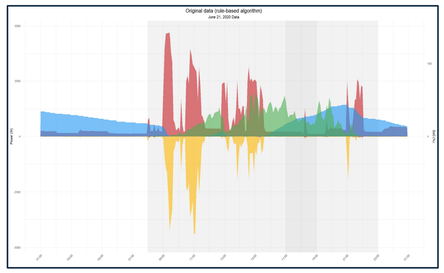


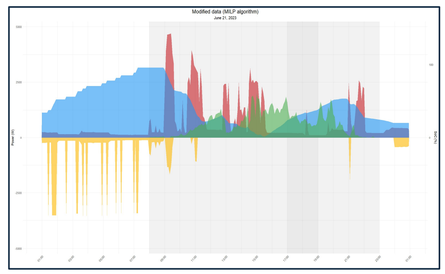
Legend: GRID LOAD SoC SOLAR SOLD

This application was concerned with minimizing cost. It achieved:

- ▲ Net savings: **+10%**
- ▲ Grid independence: **+3.46%** increase
- ▲ CO_2 emissions: **-3.81%** decrease

Site 2 – ' Standard Smart ' Tariff





This application was concerned with minimizing cost. It achieved:

- ▲ Net savings: **+22.8%**
- ▼ Grid independence: **-6.02%** decrease
- ▼ CO_2 emissions: **+5.8%** increase

CONCLUSIONS

Rule-based methods are simple but may underutilise larger batteries.

MILP optimization achieves better results but is less explainable.

Performance depends on the quality of the underlying models.

FUTURE RESEARCH DIRECTIONS

- Incorporate P2P energy trading
- Investigate performance with forecasting
- Develop academic dataset for the midlands.

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MU SUMMER PROGRAMME FOR UNDERGRADUATE RESEARCH SPUR

Maynooth University
National University of Ireland Maynooth
School of Business

REFERENCES

1. *Sustainable Energy Authority of Ireland (SEAI). (2024). Energy in Ireland 2024 Report. Dublin: SEAI.*
2. *https://github.com/ThatObiGuy/mixedIntegerLinearProgramming4Battery*